

(21) Application No 8236105  
(22) Date of filing 20 Dec 1982  
(30) Priority data  
(31) 8124224  
(32) 24 Dec 1981  
(33) France (FR)  
(43) Application published  
20 Jul 1983  
(51) INT CL<sup>3</sup>  
G02B 7/26  
(52) Domestic classification  
G2J G2 GEA  
(56) Documents cited  
GB 1555188  
(58) Field of search  
G2J  
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(54) An electro-optical connection system

(57) The present invention provides a new electro-optical connection system.

This system is formed from a connecting cable (1), having at each end a male adapter (2) and a female adapter (3) and wherein said cable (1) comprises two electric power supply conductors (6, 7) and at least one optical transmission fibre (4, 5), the male and female end adapters (2, 3), of said cable each comprising a circuit connected to said two conductors for feeding a signal converter (10, 11), the converter (10) of one adapter transforming the electric signals into optical signals, the converter (11) of the other adapter transforming said optical signals into electric signals, the optical signals being transmitted over optical fibre in which said converters are mounted, whereas the circuits for the electric signals are connected to pins or sockets of said adapters (2, 3).

FIG.1

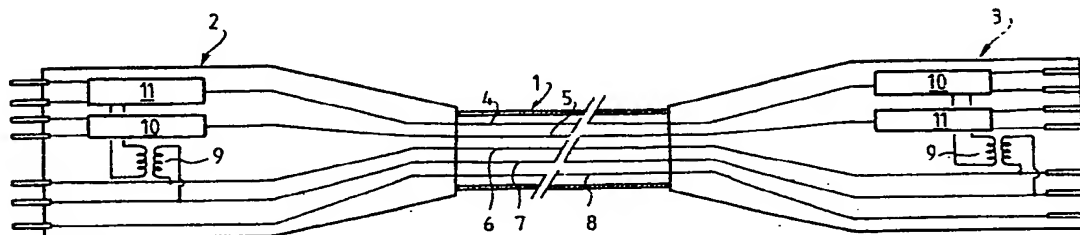


FIG. 1

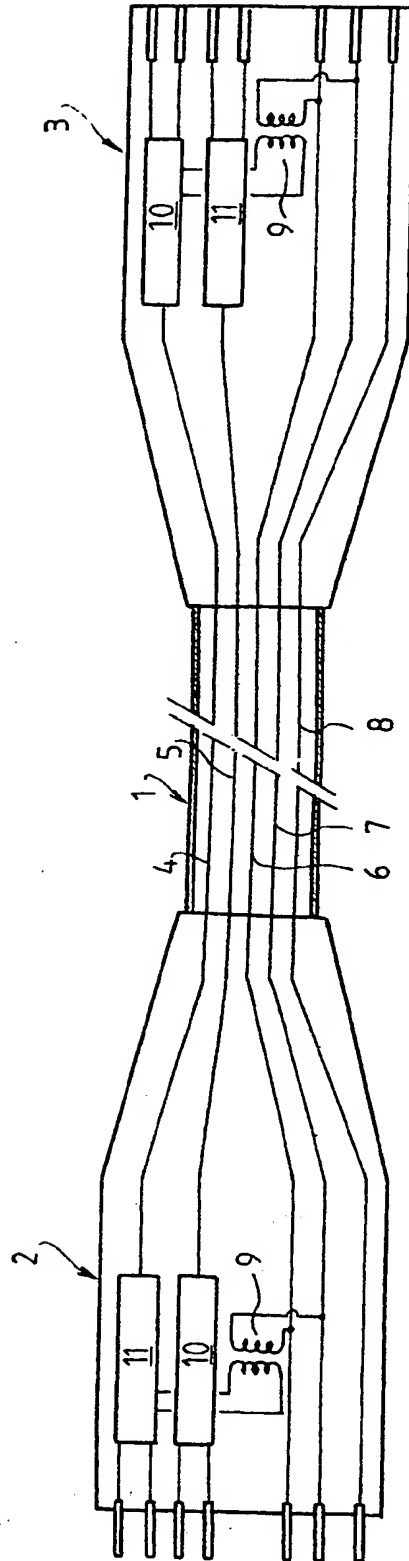
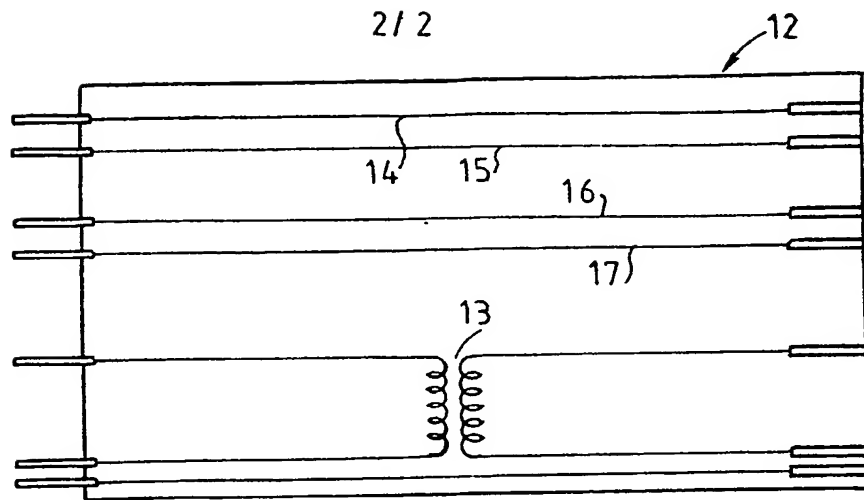
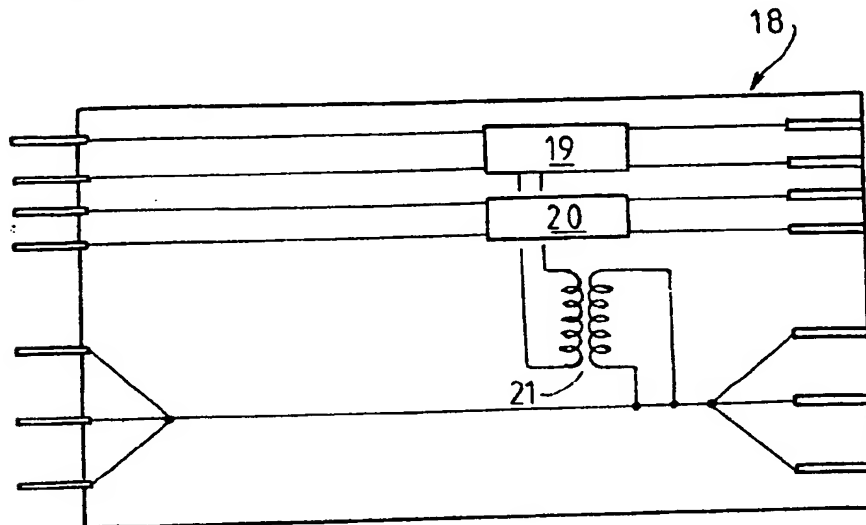
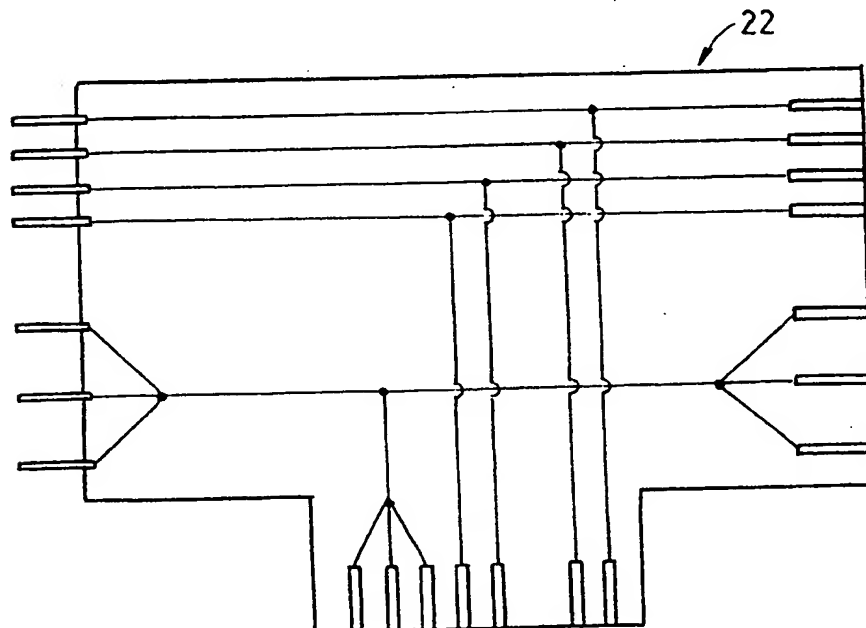


FIG. 2FIG. 3FIG. 4

## SPECIFICATION

### An electro-optical connection system

5 The present invention relates to an electro-optical connection system. It relates more especially to an electro-optical system for transmitting all modulated signals such, for example, as measuring signals, as well as remote control signals in response to the measurement signals.

10 Such a transmission normally takes place over electric conductors, but for weak signals, the attenuation becomes very high with the distance, and very distinct beyond a few hundred meters. To assist in overcoming this disadvantage, the electric signals are converted into optical signals and these latter are transmitted over optical fibres which allow transmissions without appreciable attenuation over a few kilometers.

20 The optical fibre which serves as information vehicle requires to be connected to a light emitter – for example a light-emitting diode – at the input and a photosensitive element at the output. This connection usually takes place by means of a connector generally comprising a male element in which the fibre is mounted with its output face made perfectly flat and even so as to be positioned facing the female element of said connector.

30 These elements (emitters or receivers) are themselves connected to electronic circuits adapted to the desired function.

Such a connector is perfectly suitable, is reliable and its operation gives every satisfaction, at least in sheltered and clean places. But if it is desired to use 35 this type of connector outside, on a worksite for example, there is a considerable risk of poor operation due to the introduction of dust or other particles, in particular at the time of joining the two elements of the connector together, which risks do not exist 40 for electrical connectors.

An object of the present invention is to provide a new electro-optical connection system which seeks to satisfy the requirements of practice more satisfactorily than previously proposed connectors fulfilling the same purpose, especially in that it may be used 45 in any place and at any time e.g. for remote controls, remote measurements, telecommunications or television.

According to the present invention there is provided an electro-optical connection system comprising a connection cable having at each end a male adapter and a female adapter for electrical connection which system is characterised in that the cable comprises two electric power supply conductors and 55 at least one optical transmission fibre, the male and female end adapters of the cable each comprising a circuit connected to the two conductors for feeding a respective signal converter, the converter of one said adapter being arranged to transform the electrical signals into optical signals and the converter of the other adapter being arranged to transform said optical signals into electric signals, the optical signals being transmitted by the optical fibre in which said converters are mounted, whereas the 65 circuits for the electric signals are connected to pins

or sockets of said adapters.

70 Preferably, the connection system comprises a first optical fibre for transmitting outgoing signals and a second optical fibre for transmitting incoming signals, the two fibres being adapted to transmit signals in opposite directions.

Preferably also, two connection cables are coupled together by means of an electric signal amplifying box or device.

75 Preferably also, two connection cables are coupled together by means of a supply voltage amplifying box or device.

80 Preferably also, the cable is connected directly or through amplification boxes to a dividing box comprising one input and several outputs connected electrically to the input.

The assembly formed by the cable, the adapters and the boxes are preferably sealed.

85 An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings in which:

Fig. 1 is a schematical view of an electro-optical connection system in accordance with the invention;

90 Fig. 2 is a schematical view of a voltage amplifier box-relay which is mounted between two connection systems of the invention;

Fig. 3 is a schematical view of a signal amplification box-relay, fitted between two connection systems of the invention; and

95 Fig. 4 is a schematical view of a dividing box for the connection system of the invention.

Referring to the drawings, an electro-optical system according to the invention as shown in Fig. 1 and is formed from a transmission cable 1 having at 100 each end male and female adapters 2 and 3 respectively for electrical coupling. This cable and adapter assembly is preferably completely sealed and may, consequently, be submerged.

Cable 1, in this example, comprises two optical 105 fibres 4 and 5 and electrical supply cables 6 and 7, as well as a mass or ground conductor B. This cable, considering the high transmission coefficients of present-day fibres, may have a length up to several tens of kilometers.

110 At one end, the male adapter 2 comprises a power supply transformer 9 connected between conductors 6 and 7 with, if required, a rectifier bridge for obtaining a suitable power supply; it is obvious that this assembly could be omitted if conductors 6 and 7 115 were connected directly to a DC source.

This power supply supplies the current required for two electro-optical converters 10 and 11 mounted at the end of the fibres 4 and 5.

120 Converter 10 transforms the electrical signals received from the outside into optical signals which are transmitted over fibre 5, whereas converter 11 transforms the optical signals transmitted over fibre 5 into electrical signals.

Similarly, at the other end of cable 1, the female 125 adapter 3 also comprises power supply transformer 9 and the converters 10 and 11. However, converter 10 is mounted in fibre 4 and converter 11 in fibre 5.

Such a connection system presents then the transmission advantages of optical fibres and the 130 reliability and sealing of the electrical coupling

adapters.

In some cases, it may be desired to couple together several connection cables. For this, they may be connected directly end to end, but often it is necessary to amplify the signals before transmitting them to the other cable. Further, if the voltage drop in conductors 6 and 7 is too high, it must also be compensated for by a voltage amplifier. To this end, connection boxes are provided at the male input and the female output, such as box 12 shown in Fig. 2, which comprises a step-up transformer 13 connected to conductors 6 and 7 of the cable, electric conductors 14, 15, 16 and 17 providing transmission of the electric signals coming from the converters 11 of each coupled cable.

Similarly, box 18 for amplifying electric signals, shown in Fig. 3 comprises two amplifiers 19 and 20 receiving the electric signals transmitted by the end adapters of the cables. These amplifiers are supplied with power through a transformer 21 connected to the connection conductors which couple together the conductors 6 and 7 of each cable.

Fig. 4 shows a dividing box 22 having one input comprising male plugs and two outputs with female sockets connected respectively to the male plugs, by means of electric conductors. With this box, a transmission cable may be connected to other cables and/or to electric signal receiving or processing equipment.

In the example described, cable 2 comprises two fibres 4, 5, one for each transmission direction, but the cable could comprise one or more optical fibres depending on the number and on the complexity of the electric signal transmissions to be transmitted.

### CLAIMS

1. An electro-optical connection system comprising a connecting cable having at each end a male adapter and a female adapter for electric connection, which system is characterised in that the cable comprises two electric power supply conductors and at least one optical transmission fibre, the male and female end adapters of the cable each comprising a circuit connected to the two power supply conductors for feeding a respective converter; the converter of one said adapter being arranged to transform the electric signals into optical signals and the converter of the other adapter being arranged to transform said optical signals into electric signals, the optical signals being transmitted by the optical fibre in which said converters are mounted whereas the circuits for the electric signals are connected to pins or sockets of said adapters.

2. A system as claimed in claim 1, wherein said cable comprises two optical fibres, a first adapter comprising a converter for converting electric signals into optical signals for said first fibre and a converter for converting optical signals into electric signals for said second fibre, whereas the other adapter comprises a converter for converting optical signals into electric signals for said first fibre and a converter for converting electric signals into optical signals for said second fibre.

3. A system as claimed in claim 1 or 2, wherein two connection cables are coupled together by means of an electric signal amplifying box or device.

4. A system as claimed in claim 3, wherein two connection cables are connected together by means of a supply voltage amplifying box or device.

5. A system as claimed in claim 3 or 4, wherein the cable is connected directly or through amplifying boxes to a dividing box comprising one input and several outputs connected electrically to the input.

6. A system as claimed in any of claims 2 to 5, wherein the assembly formed by said cable, said adapters and said box is sealed.

7. A system as claimed in any preceding claim, when connected to remote electric and/or electronic equipment located downstream thereof.

8. An electro-optical connection system substantially as hereinbefore described with reference to Fig. 1, Fig. 2, Fig. 3, or Fig. 4 of the accompanying drawings.

Printed for Her Majesty's Stationery Office by Tho Trecddale Press Ltd.,  
Berwick-upon-Tweed, 1983.  
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY,  
from which copies may be obtained.

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